REPORT

OF

WILLIAM WESTON, ESQUIRE,

ON THE

PRACTICABILITY OF INTRODUCING

THE

Water of the River Bronx

INTO THE

CITY OF NEW-YORK.

DONE AT THE REQUEST OF THE CORPORATION OF THE SAID CITY.

—No. 102, in Pearl ſtreet—

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M,DCC,XCIX.

CITY OF NEW-YORK, } ss. *At a Common Council, held on Saturday the 16th day of March, 1799, the following* REPORT *of* WILLIAM WESTON, Esq. *(on the practicability of introducing the* WATER *of the* River Bronx, *into this city) made at the request of this Board, was read, and ordered to be printed, viz.*

SIR,

IN compliance with the request, contained in your letter of the 18th of December last, I have taken the earliest opportunity, which my engagements and the state of the weather would permit, to ascertain the practicability of introducing the water of the Bronx into the City of New-York. The result of which investigation, I have now the honour of transmitting to you, requesting that you will lay the same before the Common Council, who, as the immediate guardians of the city, must feel peculiarly anxious to possess such information on the subject, as may enable them to determine upon the propriety of the measures, necessary to be taken to accomplish that important object.

I AM sensible that *Estimates* of the expence attendant on the execution, would have been a desirable piece of information; but a wish to render them as accurate as the uncertainty of the business will admit, induces me to request a further indulgence of time, to procure information on several material points, essential to be known, previous to the completion of the necessary calculations, but with which I am at present unacquainted.

THOUGH the *amount* of the expence, ought, and doubtleſs will, have a proper degree of influence on the final deciſion; yet perhaps it is not a diſadvantage in the firſt inſtance, that the queſtion ſhould be determined on its abſtract merits alone.

IN an object of this nature, the firſt point to be fixed, is the *Quantity* of water, neceſſary to be delivered in a given time: was nothing more required than a ſufficiency for culinary and other domeſtic uſes, the matter might be eaſily aſcertained. But as the principal object of this undertaking, is the introduction of a copious and conſtant ſupply, for cleanſing and cooling the ſtreets, it becomes a queſtion of importance to determine, as near as may be, the annual amount of the required demand. Several ſpecific quantities have been mentioned; but in my opinion, they are all inadequate to the contemplated purpoſe. In this, as in all other undertakings, I conceive it to be an object of the firſt conſequence, to have the *effect* dependent on the *will*, and where, from the nature of the thing, no certain concluſions can be obtained, it is wiſeſt to err on the ſafe ſide.

WHATEVER doubts may be entertained of this deduction as a general principle, I believe there can be none reſpecting the propriety of it in the preſent inſtance; for, however great the amount of the ſurplus water may be, there are a variety of uſeful, and productive purpoſes, to which it may be advantageouſly applied. Proceeding on this ground, I have endeavoured to calculate as near as the want of ſufficient data would enable me, the *Minimum* quantity, neceſſary to be introduced in 24 hours. Tho' concluſions deduced from Hydraulic principles of the *expence* of water iſſuing from pipes of given diameters placed on the ſummits of the ſeveral ſtreets, would have been much preferable to vague gueſſes; yet the infinite variety of caſes, ariſing from different

degrees of *depreſſion* below, and *diſtance* from the principal Reſervoir, would have rendered the operation a very laborious one, and from a variety of cauſes, the reſult very uncertain. Indeed, every mode, with which I am acquainted, may be objected to, on the latter principle, but though it is perhaps impoſſible to aſcertain the *exact truth*, we muſt endeavor to approximate as near thereto as poſſible.—Conceiving it to be the intentions of the gentlemen, who have recommended the meaſure of waſhing the ſtreets, as eſſential to the health of the citizens, to have a regular and plentiful current of water running at leaſt *twelve hours* every day, through all the ſtreets, by means of pipes placed at the reſpective ſummits, producing an effect, ſimilar to what we may obſerve to be done, by a moderate *ſhower of rain* of the ſame duration. Calculating therefore, the area of the city; the quantity of water uſually deſcending in the time above mentioned, and making due allowance for ſuch parts of the general ſurface, as are pervious to water, we ſhall obtain a reſult, that perhaps on the whole, will be as near the truth as can be done by any other mode, and ſufficient to anſwer every purpoſe required. I find that the area of the city, bounded by the Eaſt and North rivers, and the interſection of them by Grand-ſtreet, is upwards of 750 acres, and making an allowance of 350 for public ſquares, gardens, and other unpaved ſurfaces, we have a remainder of 400 acres; which being unpenetrable to the *rain*, all that falls on that ſurface, muſt be diſcharged by means of the *Channels* of the different ſtreets, into the adjacent rivers. I have made various enquiries, but have not as yet received any correct information of the quantity of water produced by a moderate ſhower, of 12 hours continuance. I am, therefore, under the neceſſity of aſſuming as a fact, what may hereafter be proved to be erroneous, though I have reaſon to believe, that my calculations will not be found to be *over-rated*.

Fixing, therefore, the depth, as ſhown by the rain-gage, at one fourth of an inch, we ſhall find the total amount to be 363,000 cubic feet, or 2,221,560 ale gallons, and adding to this 778,440 gallons, as an adequate ſupply for domeſtic conſumption, we ſhall have *Three Millions* of gallons to be introduced into the reſervoir every twenty-four hours.

I BEG leave to obſerve, that an encreaſe or diminution of the above quantity may be effected by *one* of the plans, ſubmitted to your conſideration, without materially altering the deſign or enhancing the eſtimates, while by the other, the *expence* will be nearly proportioned to the quantity required. I offer the preceding calculation, merely as an eſſay to determine a point, which as yet has remained undiſcuſſed, though of ſuch importance, that I deem it the baſis of the whole work. I ſhall readily yield to any valid reaſons, that may be produced in ſupport of variations from the above concluſions.

THE *quantity requiſite* being determined, the next point to be aſcertained, is from what *ſources* it can be moſt conveniently derived. I am acquainted with but two modes, that deſerve any conſideration. The firſt is the introduction of a *part*, or the *whole* of the waters of the Bronx—The ſecond is a ſupply obtained from the ſprings of the Collect. As this queſtion has much agitated the public mind, and each plan in its turn been extolled or decried by their reſpective advocates and opponents, it has produced, (what is frequently the effect of a colliſion of ſentiments) a more obſtinate attachment to pre-conceived opinions. I do not, therefore, expect that any arguments which I ſhall produce, will reconcile the jarring intereſts. Yet I truſt that the ſtatement I ſhall offer, (and it is the reſult of ſome experience and reflection), will enable thoſe whoſe province it is to judge of the merits and diſadvantages of the different

plans, to ſelect *that*, which on the whole ſhall be moſt conducive to the public welfare.

In order to form a correct opinion on the ſubject, it is neceſſary to take into conſideration, the *efficiency* of ſupply; the *quality* of water, as it reſpects the different uſes to which it is to be applied; and the *expence* of execution.

On the firſt of theſe heads, I am aware that it has generally been believed, and pretty confidently maintained, that at thoſe ſeaſons, when the demand will be greateſt, and moſt eſſential, that the waters of the Bronx are wholly inadequate. Theſe aſſertions have been made with a degree of poſitiveneſs, that would induce one to believe, they were founded on the moſt careful and accurate *experiments*, which I have every reaſon to imagine, have as yet never been made; inſtead of which, I have no doubt they are the random gueſſes of ſuperficial obſervation. The queſtion is of ſuch importance, that we ought to be very careful, that we proceed upon the moſt certain grounds. In a matter of this conſequence, I may be allowed to be a little diffuſe.

It is evident that at the period, when the greateſt ſupply of water is wanted, there will, from natural cauſes, be the leaſt quantity furniſhed. This is a common principle, applicable to all rivers, and ſprings; the very few examples to the contrary, are mere exceptions to the general rule. This circumſtance, has created doubts in the minds of many perſons of the efficiency of the Bronx. Previous to my examination of that ſtream, I had regretted that proper experiments had not been made, at the ſeaſon above alluded to, as then the fact would have been aſcertained beyond all diſpute. It is univerſally allowed, that for the greateſt part of the year, there is a ſuper-abundant quantity; what the

diminution may be, is not eaſily aſcertained; we muſt rely altogether upon the information of thoſe perſons, whom a long reſidence has afforded the beſt opportunities of judging of its uſual decreaſe; but as not materially intereſted on the ſubject, we cannot expect any conſiderable degree of accuracy in their obſervations—Allowing for this circumſtance, I have been careful to take the loweſt average of the reſults of three diſtinct caſes, founded on the beſt data I could procure, and applying to them well known Hydraulic laws, I am perſuaded that the natural ſtream of the Bronx alone, if conveyed without waſte, would be fully adequate to the ſupply before mentioned; but fortunately a minute accuracy is not required, as will appear by the following account of the

River Bronx,

Whose principal ſource is from a Lake, about 4 miles to the Northward of the White Plains, known by the name of Rye Pond. This is a beautiful ſheet of water, upwards of a mile in length, containing, as appears from an old ſurvey, upwards of 500 acres of water; which flowing from the outlet, is received into another pond, a ſhort diſtance below; whoſe area exceeds 50 acres. From this pond it deſcends with a rapid current upwards of a mile, to Mr. Robens's Mill; a few rods below which, it unites with the other branch of the Bronx. This laſt, which has its origin in a ſwamp a few miles to the Northward, retains the name of the Bronx, to its ſource; yet it is the leaſt conſiderable ſtream, particularly in the Summer, when it is reduced to a ſmall current; while the other branch is ſufficiently large, to turn an overſhot wheel, twelve hours out of twenty-four, in the drieſt times. Rye Pond is bounded by high and bold ſhores, which tending towards each other at the outlet, are admirably calculated for the form-

ation of an immenſe Reſervoir. This being filled during the winter and ſpring, may be retained until the month of July, when the natural ſupplies begin to diminiſh, it may then be diſcharged periodically, ſo as to afford any given quantity of water, that may be requiſite for the uſe of the city.

This Lake is ſupplied wholly by ſprings, many of which are internal, and few of the others originate more than a mile from the head; theſe are ſo conſtant and copious, that no doubt can ariſe of their capacity to fill the Reſervoir to the contemplated height of *ſix feet*, which may eaſily be effected by throwing a dam acroſs the outlet of the lower pond; this would form a ſheet of water of more than 600 acres in extent, containing 959,713,920 gallons of water; affording (independent of the natural ſtream of the Bronx) a diurnal ſupply of nearly *Eight Millions* of gallons, for 120 days; three eighths of which quantity is ſufficient for our purpoſe; the ſurplus, *Five Millions* may be given to the Mills below the point of partition; ſo that inſtead of injuring (and conſequently recompencing them for the damage,) the Mills on the Bronx as has been generally apprehended, they will derive eſſential benefits from the meaſure. Having, I flatter myſelf, removed the doubts of the moſt incredulous, reſpecting the efficiency of the ſupply to be derived from the Bronx, it remains to examine the competency of the waters of the Collect. The general bias of opinion ſeems to lean in favour of this ſcheme; and if it can be made ſatisfactorily to appear, that the required ſupply can be obtained from this ſource, I am ready to allow that it is a work, that would be ſooneſt accompliſhed, and attended with the leaſt expence. But we ought to be extremely cautious in hazarding an experiment, where the *cost* would be ſo great, and the *event* ſo doubtful. The queſtion is of infinite importance, and unfortunately, *one* that cannot be

determined by abſtract reaſoning. The *capacity* of the Collect, has been attempted to be proved, by its preſent extent, but that in my mind is a moſt fallacious mode of reaſoning; for however *great* that may be, a powerful Steam Engine would ſoon exhauſt it, unleſs repleniſhed with *numerous* and *copious Springs;* on theſe alone, therefore, it is evident we muſt depend; and I know of no other mode of eſtimating their combined effect, than by calculating the *quantity* of water iſſuing from the outlet of the Collect; which even at this time is ſo inconſiderable as ſcarce to deſerve attention, and if my information is correct, it ceaſes to flow altogether in the ſummer. I am ſenſible that we ſhould not too haſtily conclude, that the above is the total amount of the *ſupply* that may be derived from this ſource; I think it very probable, that from the nature of the *ſurrounding ground*, (which is a coarſe and porous gravel) a conſiderable portion thereof, may percolate through, into the adjacent rivers. Much, and perhaps the greateſt quantity, is alſo daily drawn off by the Tea-Water Pump; which from its vicinity, I have no doubt is ſupplied from the ſame ſource.

It is true that by ſinking *deeper* into the earth, an augmentation of *quantity* would be procured, yet if we went lower than the ſurface of the Tide Water, I apprehend that the *quality* would be materially injured. Leaving the queſtion, as I fear it will remain, undetermined, we next proceed to examine the *quality* of the reſpective waters. To appreciate their merits fairly, we ſhould judge of their utility, by the extent of their application: Proceeding on this ground, I believe it may be ſafely affirmed that the water of the Bronx, is at leaſt *equal* to that of the Collect, though this is contrary to the general opinion. The only reaſon that I can perceive for the preference uſually given to the laſt mentioned, ariſes ſolely from its ſuperior coolneſs. However grateful

this may be to our feelings, it does not follow that it is equally conducive to our health; for whatever degree of purity it may now poſſeſs, the period is not very remote, when from the natural encreaſe of the city, theſe ſprings muſt be ſubject to thoſe contaminations, which have already rendered ſo many wells unfit for uſe; an evil that is daily encreaſing, and to which no effectual remedy can be applied.—This to me has ever appeared an unſurmountable objection. The idea of ſupplying a large city with *Pure* Water, from a Reſervoir in its *center*, has always been a very ſtrange one to me. From the repreſentations made reſpecting the water of the Bronx, I believe many perſons have haſtily concluded that it was unfit for uſe. When it is conſidered that the principal cities in Europe, are neceſſarily ſupplied from *Rivers*, and with water, generally taken from thoſe parts, which from a variety of cauſes, are moſt impure, and yet that the experience of ages has not evinced any known ill effects, ariſing from the practice, I conceive that little fears will be entertained of the ſalubrity of the water of the Bronx—which is a collection of innumerable Springs, iſſuing from a rocky and gravelly country, and running with a rapid current, over a *bed* of the ſame materials. It will be conveyed into the city without any additional impurity, and e're it is diſtributed from the Reſervoir, will by a mode of purification hereafter deſcribed, be rendered as clear as Spring Water.

The next object to be aſcertained, is the *practicability* and *probable expence* of accompliſhing the reſpective plans: And here it may not be amiſs to obſerve, that in a matter of ſuch immenſe conſequence to the preſent and future convenience and welfare of the city, every local view, every ſubordinate conſideration, ſhould yield to the general good; that a regard to the primary object alone, ſhould decide the queſtion, regardleſs of a paltry difference of expence,

or the immediate emolument to be derived from the undertaking. On the firſt of the above mentioned heads, there have been a diverſity of opinions, which, previous to an actual ſurvey, was not to be wondered at. Theſe doubts muſt now be removed, as it appears from the examination that has been recently made, that the Bronx is ſufficiently elevated above the higheſt parts of the city, to introduce its waters therein, without the aid of machinery; and the intermediate ground, though very irregular, preſents no obſtacles which *art* and *induſtry* may not ſurmount. A general view of the ſubject, is all that I am able now to preſent; and all that is neceſſary to be known, in this ſtage of the buſineſs. An outline of the plan, I would recommend for adoption, as beſt adapted to the varying face of the country, will be ſufficient to enable you to form a tolerable correct idea of the eligibility of the meaſure.

The beſt ſituation I have yet ſeen to draw the water from the Bronx, is a ſhort diſtance above Mr. Lorillard's Snuff Mill; a break in the weſtern bank, enables us to divert the ſtream (by means of a dam thrown acroſs it) without any difficulty. The water being raiſed ſix feet above its natural level, will flow over a ſmall ſwamp, from which originates the little rivulet called *Mill Brook;* following the direction of this ſtream, a canal may be drawn along its northern bank at a ſmall expence, for the diſtance of three miles; when the ground falling off rapidly, renders it neceſſary to croſs the valey in which Mill Brook runs, by means of an *aquaduct*, to the oppoſite riſing ground; along which the level may be preſerved, to the heights above Haerlem river. An open walled canal, will be the cheapeſt mode of conveying the water ſo far; a little loſs is not material, as a ſmall increaſe in the *ſection*, will remedy ſuch waſte.

A DECLIVITY of 6 inches in a mile, with a ſection of 1,152 and linear border of 89 6-10 inches, will occaſion a velocity in the current ſufficient to introduce into the ſmall reſervoir at the extremity of the canal, 6 cubic feet of water per ſecond; which is more than the quantity required, ſuppoſing the daily ſupply to be *three millions* of gallons. The moſt difficult and expenſive part of the route, will be the conveyance of the water acroſs Haerlem river, the moſt eligible mode of effecting this, appears to me, to be by means of caſt iron cylinders, of two feet diameter, with a difference of 8 feet between the extremities. This deſcent will produce a velocity of 22 3-4 inches per ſecond, yielding in that time 5 95-100 cubic feet, while the required quantity is only 5 65-100. From the Cylinder to the Reſervoir, it is a matter of conſequence to preſerve as much of the water as poſſible: to effect this object, the bottom and ſides ſhould be rendered impervious to that element. An abſolute neceſſity to preſerve a regular and uniform deſcent, leaves us little room, in the choice of our route; which will be chiefly along the ſhore of the North river. The *quality* and *make* of the ground, vary much: the greateſt impediments are occaſioned by the numerous ravines, which interſect the line of the Canal—over all theſe, aquaducts muſt be conſtructed. The level may thus be preſerved upwards of 6 miles, or within 2 miles of the city; there it deſcends ſo much, that unleſs higher ground can be found, it will again be neceſſary to have recourſe to iron Cylinders, to convey the water into the Grand Reſervoir, which may either be placed in the Park, or a vacant piece of ground to the Northward of the Hoſpital, either of which are ſufficiently elevated to diſtribute the water through all parts of the city.—The total diſtance from the Bronx to the Park, is 14 miles 7 furlongs, and the *deſcent twenty three feet.* It is to be obſerved that the principal object of this ſurvey, being to aſcertain the practicability of the

plan, and neither my time or the ſeaſon, permitting that minute inveſtigation, which is neceſſary to be made, previous to the commencement of any operations, there is a probability that advantageous deviations may be made from the route purſued.

ALTHOUGH the *form* and *dimensions* of the reſervoir, are objects of importance, it is now premature to point out the particular mode of conſtruction I would recommend to be adopted; yet it may not be improper to give a general outline thereof, as perhaps it may tend to remove many of the prejudices which have been entertained againſt the ſuppoſed impurity of the waters of the Bronx. It is propoſed to divide the Reſervoir into *three* parts, two of which will again be ſubdivided; each of theſe minor diviſions capable of containing a daily ſupply of water. The firſt diviſion, or reſervoir of *Reception*, will contain the water as immediately delivered by the Cylinder of diſcharge; while *one* of its *ſubdivisions* is *filling*, the *other* in a *quiescent* ſtate, will be depoſiting the adventitious matter, with which the water may be intermixed. After ſo remaining 24 hours, it will be drawn off by an aperture near the bottom (ſo as to prevent any buoyant particles from entering) into the Reſervoir of *Filtration*, where it will ſtill further purify itſelf, by gradually depoſiting the remaining ſediment, until it is finally received into the Reſervoir of *Diſtribution*, after percolating through a bank of waſhed ſand and gravel, (in imitation of that natural proceſs to which all water owes its purification)—This laſt Reſervoir it is propoſed to Arch over, ſo as to preſerve the water pure and cool; from hence it will be diſtributed in ſeparate and diſtinct pipes, through every part of the city.

THE water deſtined to cleanſe and cool the ſtreets may be taken immediately from the Reſervoir of re-

ception, as I conceive it is not neceſſary, that it ſhould be very pure.

The ſurplus water, which for a conſiderable part of the year, will not be wanted for waſhing the ſtreets, may be applied to a variety of purpoſes, but perhaps to none more uſeful or advantageous, than the ſupplying of *Dry Docks*, which may be conſtructed to receive the largeſt ſhips.

If the water in the Collect is deemed adequate to all the purpoſes of domeſtic conſumption, it muſt be raiſed by means of a Steam Engine, into a Reſervoir; the ſituation before mentioned, will in this caſe be very convenient—Although one Engine might be conſtructed, ſo as to raiſe, both the water for waſhing the city, and for family uſe; yet as from the quantity neceſſary to be raiſed, it would be unwieldy in its parts, and more liable to accident, and alſo as two thirds of its powers would be uſeleſs the greateſt part of the year, I believe it will be moſt adviſeable to erect *two*—the firſt deſtined to raiſe the water for cleanſing the ſtreets, placed at the foot of the hill, to the northward of the hoſpital; which would be ſupplied with water from a *reſervoir* made in the adjacent low ground. This would be repleniſhed twice in twenty-four hours by the tide, by means of an open canal, or culvert, communicating with the reſervoir. The ſmall engine might be placed near the other, the pump well being ſupplied with water from the collect, conveyed in a culvert or pipes. The following calculations of the dimenſions of the largeſt engine, will be found ſufficiently correct, to enable you to form a tolerable idea of the annual expence attendant on it. Admitting the quantity (as before calculated) to be ſufficient, we find that 2,200,000 gallons, or 359,640 cubic feet muſt be daily raiſed. Suppoſing the engine to work 16 hours out of 24, we have 22,477 feet to be raiſed every

hour, or nearly 375 every minute, eſtimating ten ſtrokes to be made in a minute, each ſtroke muſt yield 37 1-2 feet; but as pumps generally fail in producing the calculated quantity, ſay 40 *feet* per ſtroke; and if the lengths of the ſtrokes are 8 feet, it will require a pump of 30 27-100 inches diameter; but a pump of that dimenſion would not anſwer in practice; it will be neceſſary therefore, to diminiſh the diameter and increaſe the number of pumps; ſix of 12 3-10 inches will be equal in area to that beforementioned. As the water would be raiſed about 50 feet, the weight of the column would be 15613 lb, which would require a cylinder of 44 2-10 inches diameter (allowing the active power of Meſſ. Bolton and Watts engines to be 8 lb on every circular inch) ſuch an engine would conſume about 330 lb of coal per hour.

HAVING thus given you every information neceſſary to be known for your guidance, I ſhall conclude by remarking, that my objections to the Collect (being founded on the doubts I entertain of its efficiency to ſupply the annual increaſing demand of this improving city, and to the contamination its waters will be ſubject to) will be done away altogether, when it ſhall be made to appear that they are groundleſs; in ſuch a caſe, there can be no queſtion which plan is moſt eligible as it reſpects the *time* and *expence* of execution.

I am, Sir,
With Reſpect,
Your obedient Servant,
WILLIAM WESTON.

The Hon. RICHARD VARICK.
New-York, March 14, 1799.

Printed by order of the Common Council,
ROBERT BENSON, *Clerk.*